Migration syndrome in three-spined sticklebacks

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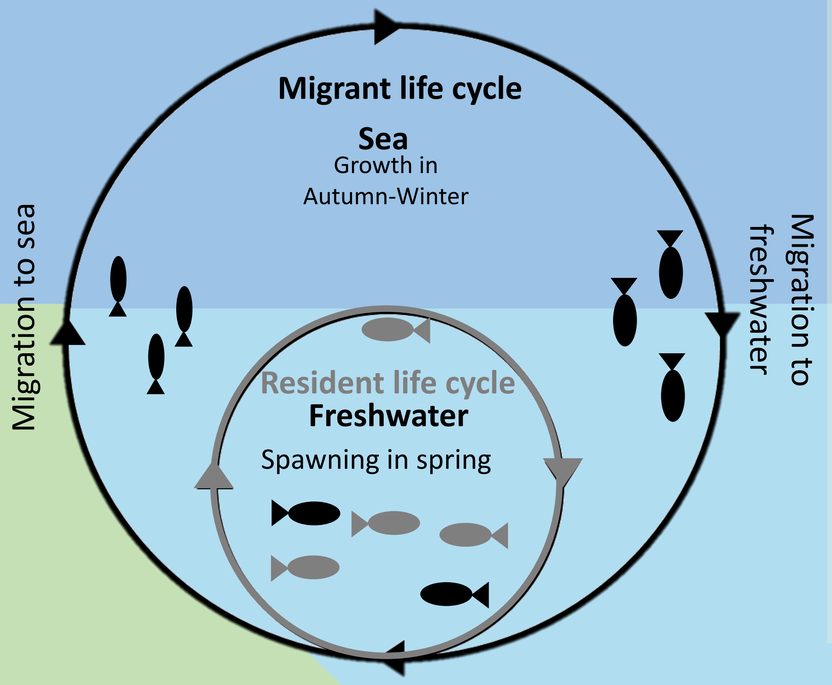
Classical migration theory predicts that migrants are a random subset of the population. But recent studies have increasing found evidence that migrants vary systematically in suites of traits from residents ('**migration syndrome**') that reduce the costs of migration. In this starting project, we compared populations of sticklebacks exhibiting **partial migration** and land-locked populations in the Netherlands. We take an integrative approach to address whether the well-known morphological differences between migrants and non-migratory individuals are associated with behavioural differences corresponding to a migration syndrome. Our preliminary study confirms that migrating and non-migrating land-locked forms diverge phenotypically, i.e. they are two ecotypes.

Partial migration

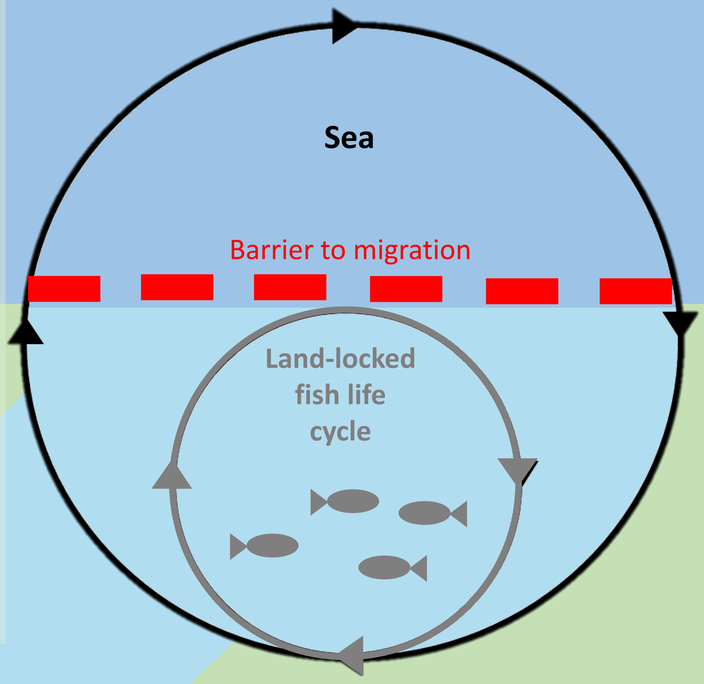


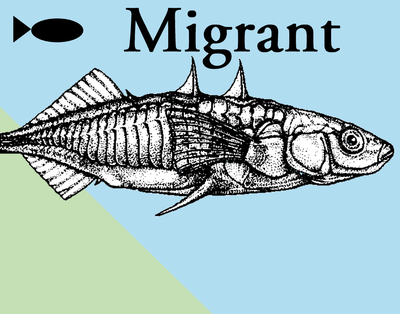
Migrants (N=189) were caught at sea-side when entering inland waters and land-locked fish (N=76) were caught at streams enclosed by land. Caught fish were transported to the lab where they were assayed for morphology and behaviours. Tissues were collected for DNA analyses.

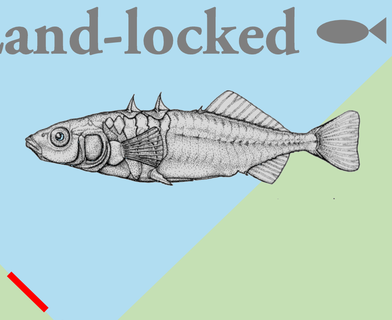
Morphology | **Behaviours** | **Genetic divergence**

Activity
Aggression
Boldness
Shoaling
Exploration

No migration

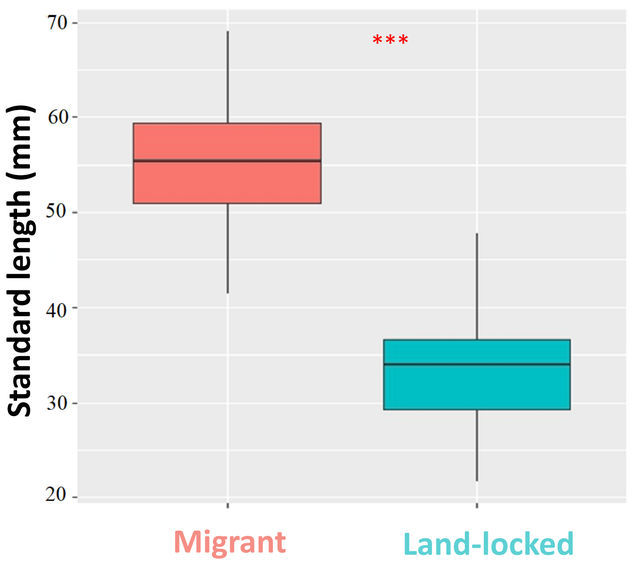






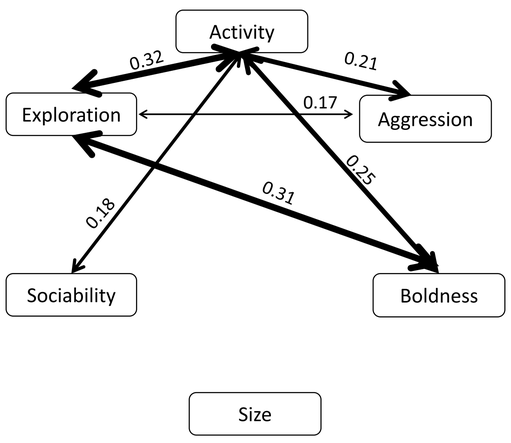
Results

1. Morphological differences

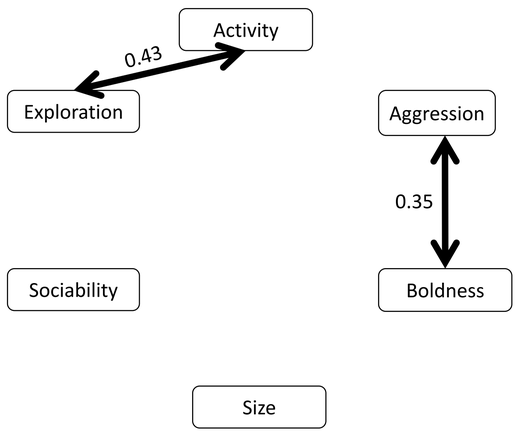


1. Migrants are significantly bigger (Mean diff: 21.5604, SE: 0.8580)

2a. Syndrome in migrants

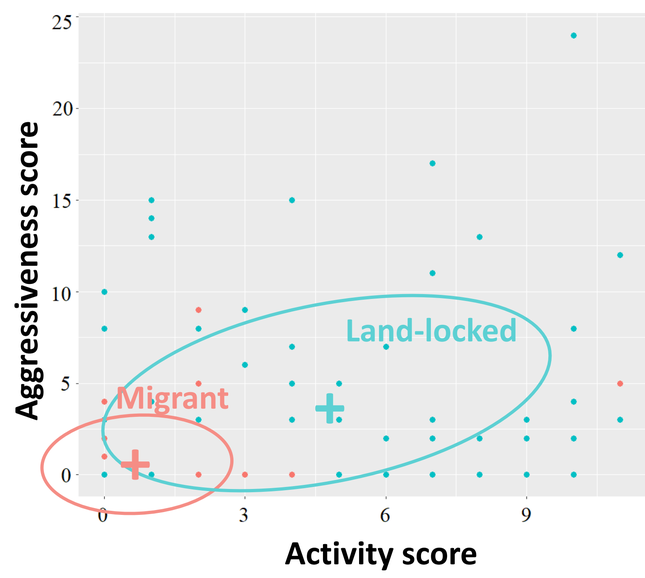


2b. Syndrome in land-locked fish



2. From the correlation structure and strength (i.e. coefficients), we find that behaviour syndromes are very different in migrants and residents .

3. Behavioural differences



3. An example of behavioural correlation. (Activity: Mean diff: 3.9478, SE: 0.3733; Aggression: Mean diff: 4.0550 , SE: 0.5095)

Discussions

- Body sizes of migrants are significantly bigger compared to residents – this is similar to previous results.
- Some correlations can be selected for to minimize costs of migration but further studies are required to establish this.
- Contrary to expectations, migrants exhibit significantly lower scores for all behaviours than land-locked (except shoaling). Possible explanation is that migrating itself can be considered a risky behaviour and migrants need to be more cautious of their local environment and take less risks to ensure better survival.
- Migrants exhibit lower variation in levels of expression of behaviours compared to land-locked fish. This can potentially be due to stabilising selection on migrants to endure the costs of migration.

Future directions: What shapes migration syndrome and decision to migrate? Early conditions as juveniles? Parental effects?

We thank the water authorities of Groningen, Hunze en Aa's for their help with this project